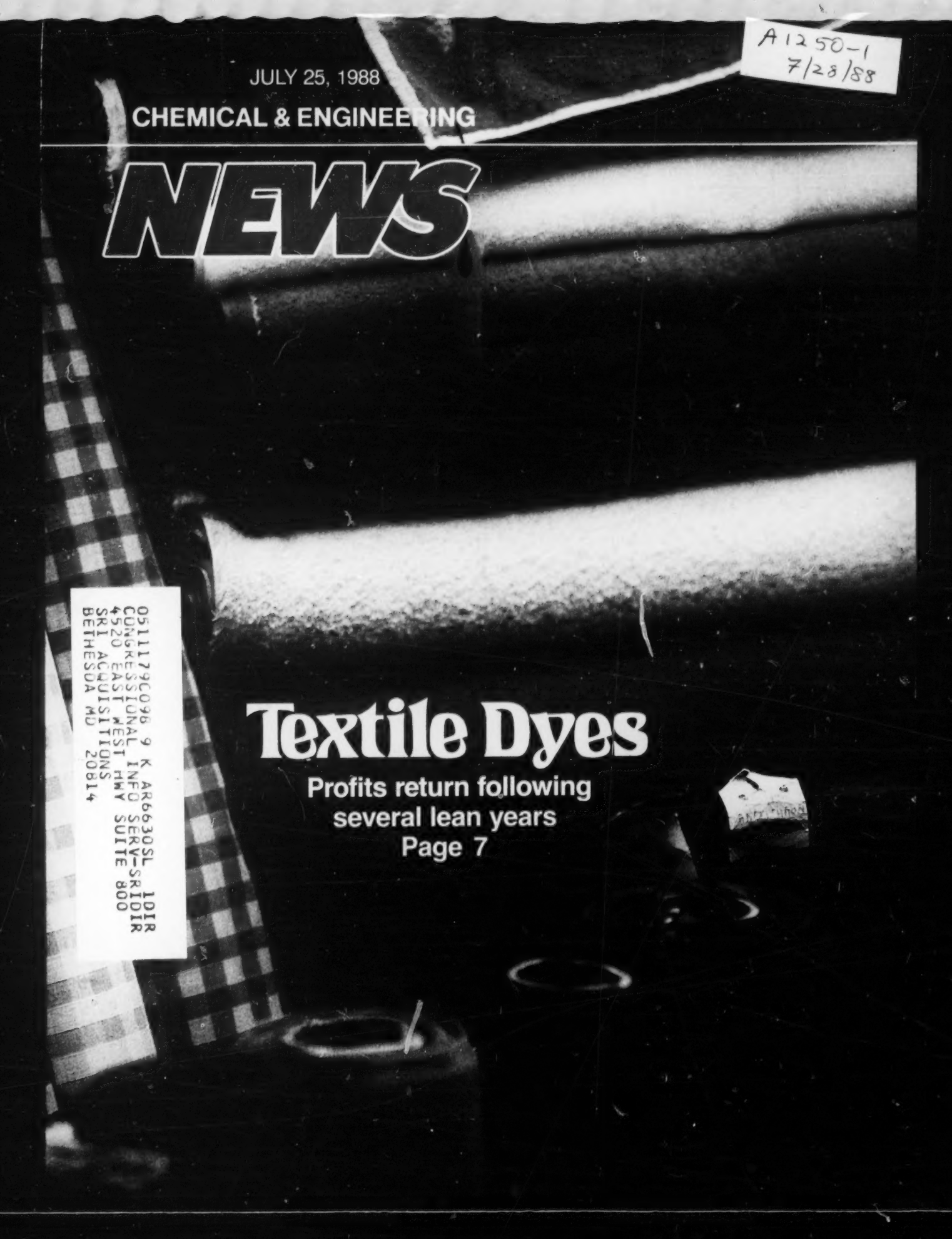
A1250-1
7/28/88

JULY 25, 1988

CHEMICAL & ENGINEERING

NEWS



Textile Dyes

Profits return following several lean years

Page 7

05111790096 9 K AR6630SL 1DIR
CONGRESSIONAL INFO SERV-SRIDIR
4520 EAST WEST HWY SUITE 800
SRI ACQUISITIONS
BETHESDA MD 20814

CHEMICAL & ENGINEERING
NEWS

Volume 66, Number 30
CENEAR 66 (30) 1–40
ISSN 0009-2347

JULY 25, 1988

News of the Week

■ **Prominent Soviet scientists and Soviet leader Gorbachev criticize Soviet scientific system and urge reforms.** **Page 4**

■ **Tight supplies of ethylene have prompted Chevron and Exxon to build a terminal on Houston Ship Channel to import large quantities of ethylene.** **Page 5**

■ **Based on DNA profiling, Virginia man is found guilty of rape and murder and sentenced to die in electric chair.** **Page 5**

■ **Chemical company earnings are strong in second quarter, with Wall Street analysts recommending chemical stocks to their customers.** **Page 5**

■ **In effort to determine the level of risk from hazardous air pollutants that society will accept, EPA proposes four alternative approaches to regulating benzene emissions.** **Page 6**

Cover: Photo by Jim Scruggs/ Uniphoto Picture Agency

Letters 2

Concentrates

Business 15
Government 18
Science/Technology 23

The Departments

Meetings 28
Newscripts 40

Business

Chemical employment in June was at its highest level since 1982, according to the latest data from the Labor Department. **Page 17**

Government

New U.S.-Japan science and technology agreement establishes joint R&D efforts, but contains national security and intellectual property clauses that could cause problems in the future. **Page 19**

Technology

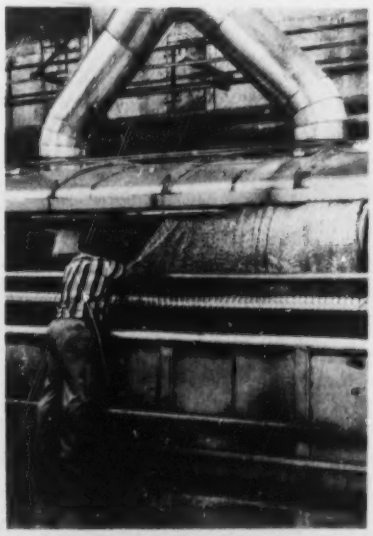
Polymer-based adsorbent that cleans up gaseous plant emissions may outperform the more conventionally used activated carbon. **Page 24**

Spider silk gene promises route to high-tensile fiber for use in bullet-proof vests and similar protective garments. **Page 24**

Stable isotope labeling of emissions from coal-fired power plants could trace smoke particles over long distances and identify particle source. **Page 25**

Books

"Handbook of Research Laboratory Management" by Virginia P. White focuses on administration of large research institutions, but doesn't live up to status as a "how to" book. **Page 26**



News Focus

Following some lean years, the U.S. dye industry is once again profitable, largely because capacity is more in line with demand and the textile industry, its biggest customer, is going strong. **Page 7**

Chemical & Engineering News

1155—16th St., N.W., Washington, D.C. 20036

Editor: Michael Heylin
Assistant Managing Editors: David M. Kiefer, James H. Krieger, Janice R. Long, Donald J. Soisson, William J. Storck. **News Editor:** Wilbert C. Lepkowski
Staff Editor: Ernest L. Carpenter
Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; Washington: Doron Dagani, Lois R. Ember, Rebecca L. Rawls, Pamela S. Zurer
Associate Editors: Stuart A. Borman, Mairin B. Brennan, Bette Hileman, Richard J. Seltzer
Service Departments Editor: Dolores Miner
Editing Services: Anne Riesberg (Head), Arlene Goldberg-Gist (Editorial Assistant), Patricia Oates (Administrative Assistant)

News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Assistant Editor), Rachel Eskenazi (Administrative Assistant). Chicago: (312) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head), Patricia L. Layman (Associate Editor)
Graphics and Production: Leroy Corcoran (Manager). Alan Kahan (Art Director). Barbara Fryer (Production/Art Director). Linda Mattingly (Staff Artist). Diane Kelly (Costing). **Business Manager:** Arthur Poulos
Circulation Development: Cynthia G. Smith

ADVISORY BOARD: William J. Bailey, Jacqueline K. Barton, Ernest H. Drew, Harry G. Drickamer, A. Nicholas Filippello, Myron Foveaux, Vincent L. Gregory Jr., Adam Heller, John D. Holmfeld, Isabella Karle, Koji Nakanishi, Richard Nicholson, Howard A. Schneiderman, Ellen K. Silbergeld, Howard E. Simmons, Robert M. Simon, William P. Slichter

Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-8733
John K Crum, Executive Director

PUBLISHING BOARD: Ned D. Heindel (*Chairman*); *Board of Directors Chairman:* Ernest L. Eliel; *President:* Gordon L. Nelson; John H. Nelson; Louis D. Quin; Jean'ne M. Shreeve; and Barbara G. Wood

© Copyright 1988, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: Controller, ACS, P.O. Box 28597, Central Station, Washington, D.C. 20005. Correspondence and telephone calls for changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Membership & Subscription Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (614) 421-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1988. Printed editions: nonmembers U.S. 1 yr. $49, 2 yr. $83, outside U.S. 1 yr. $75, 2 yr. $135. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $7.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management
CENTCOM LTD.
(For list of offices see page 39)

LETTERS

Symbiosis of art and science

SIR: I certainly agree with your editorial comment in the article "The Chemistry of a Stradivarius" (C&EN, May 23, page 24) that "the secret of Stradivari may not be one thing but rather many, all combined in the correct proportion." This viewpoint is very well illustrated by my own experience in collaboration with David Rubio, luthier of Cambridge. His consummate craftsmanship has been allied to a wood treatment prompted by our own examination of an authentic Stradivarius instrument [Barlow, C. Y., Edwards, P. P., Millward, G. R., Raphael, R. A., and Rubio, D. J., *Nature*, **332**, 313 (1988)].

Using this treatment, he has created more than 100 violins, violas, and cellos of superb quality, which have been avidly acquired on completion by that most demanding of clientele, professional string players. The waiting list now stretches four years hence! The whole venture constitutes an excellent example of a true symbiosis of the arts and sciences.

R. A. Raphael
Professor of Organic Chemistry
University Chemical Laboratory
Cambridge, U.K.

For the good of all

SIR: Regarding the letter from C. J. Guare (C&EN, March 21, page 4), usually good reasons exist for the use of technical terms whether in chemistry, in medicine, or in law. Such terms frequently are more definitive than common general terms, and convey more precise information to the reader/listener.

"Pro bono" does not mean "free." Pro bono is short for "pro bono publico," meaning for the public good or for the good of all. It is a service that attorneys provide to all those who need legal assistance but cannot afford it. It is not a giveaway.

"Per stirpes" is not the equivalent of "descendents." Descendents is a general term naming any and all descended from X, however remotely, without regard to degree or generation.

Per stirpes, however, refers to a right of two or more successors to a deceased predecessor to take the deceased predecessor's share of an intestate estate, not by head count, so to speak, but by equal shares of the deceased predecessor's right. Thus, if by intestate succession Y and Z would be entitled to a one-half share each in an estate of X, but Y and Z are now deceased, Y having three children and Z having one, the one-half share to Y would be divided among the three children one-sixteenth share each, and the one-half share to Z would go to his child. If a distribution was simply "by descendents," presumably by head count, each child would have received a one-fourth share. Per stirpes is much more precise.

Making things (for example, communications) more complex makes communicating more difficult only if the language used is imprecise or inaccurate.

Lyell H. Carver
Attorney and Counsellor at Law
Bartlesville, Okla.

Harm of chemicals

SIR: Robert D. Kennedy, in his guest editorial (C&EN, May 23, page 3) failed to mention an ominous development affecting the public's perception of chemistry.

Two years ago, my secretary, who lived in Northfield, Ohio, brought to the office some posters that her 12-year-old daughter had entered in a junior high school contest. The legends read, "Say No to Chemicals," "Promise Not To Use Chemicals," "Chemicals Ruin Lives," and so on.

In this school (and I'm afraid in many others), children are not equating the word "chemical" with "pollution, hazardous wastes, or some type of accident," as Kennedy suggested. Chemical, at least in the experience I cite, is a synonym for alcohol, tobacco, cocaine, and heroin. I asked the girl's mother if the contest had been conducted as part of a campaign against drugs. No, the children's specific directives had been about the harm of chemicals.

Chemistry's first goal, then, must be to educate the educators! Obviously the Pharmaceutical Manufacturers Association (or its equivalent) has done a better job in this respect than has ACS!

Saul Kaye
Evanston, Ill.

Computer-aided design

SIR: After reading the article concerning computer-aided molecular design (C&EN, Feb. 1, page 24), a reader is left with the impression that the software package, Biograf, is the only menu-driven, interactive program available. I would like to bring to the attention of your readers another package called MacroModel.

MacroModel was started in the spring of 1984 by W. Clark Still and his associates in the department of chemistry at

Better Times Ahead for U.S. Dye Producers

With production up, capacity more closely matching demand, and the textile industry, their largest customer, operating at or near capacity, dyes have returned to profitability

Marc S. Reisch, C&EN New York

"If I had to characterize the dyestuffs industry," says David S. Alcorn, vice president of the Dyes & Chemicals Division of Crompton & Knowles, "it would be to say that the profit picture has brightened for U.S. dye producers."

Only eight years ago, U.S. dye manufacturers sold dyes valued at close to $800 million, according to U.S. government data, to customers in the textiles, plastics, paper, and ink industries. In 1986, the latest year for which government data are available, sales of U.S. synthetic organic dye production had declined to $652 million. Industry overcapacity, the high volume of U.S. textile imports, and the ever-increasing burden that compliance with environmental regulations have placed on dye manufacturers have caused, in large measure, the decline.

In fact, the high cost of complying with environmental regulations will force the closure of dyes synthesis at Ciba-Geigy's Toms River, N.J., plant sometime during 1989, says Leslie G. Polson, senior vice president of the company's Dyestuffs & Chemicals Division. The largest dye producer in the U.S., Ciba-Geigy plans to build a replacement plant in St. Gabriel, La., which is scheduled to begin operating in 1990, he says.

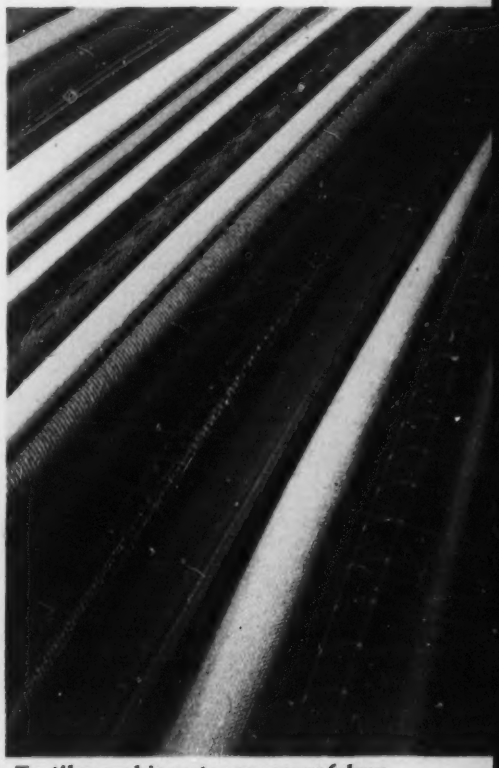
But dye makers say that better times for the U.S. dye industry are ahead because industry capacity has been severely restricted over the past few years so that it more closely matches demand. And the U.S. textile industry, which consumes anywhere between two thirds and three fourths of annual dye production, is operating at or near capacity.

The gut feeling among dye producers is that both the value and quantity of dyes produced in the U.S. increased in 1987 and will increase again this year. "1987 was a peak year for the dye business because of heavy demand for oversize garment dyes in deep bright shades," says David G. Duncan, textile dyes production manager for ICI Americas. He estimates 1987 industry sales at $700 million to $750 million and expects similar results in 1988.

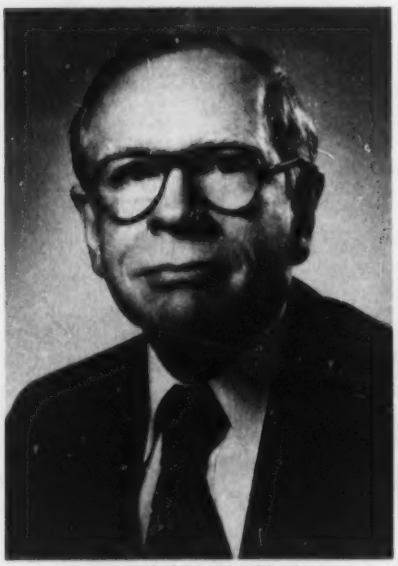
"The industry is now running at a good pace," says Heinz P. Geiss, vice president and general manager of the Colorants & Auxiliaries Division of Hoechst Celanese. "Dyes are now a profitable business," he adds, though they are "not as attractive as other specialty chemicals businesses because of the high cost of remaining in the business," stemming from inventory costs and technical service costs.

"The dye industry is at least growing now at the rate of sales increases in the textile industry," says Crompton & Knowles' Alcorn.

Although government data exist for total industry sales and individual dye class sales, sales figures for individual dye makers are difficult to come by. None of the dye makers C&EN contacted would divulge their dye production or sales figures, citing competitive and confidentiality reasons. It is clear, however, that the largest position in the U.S. dye industry is held by the U.S. subsidiaries of major European dye producers.



Textiles are biggest consumer of dyes



Alcorn: brighter profit picture

Industry sources say that Swiss-based Ciba-Geigy is probably the largest full-line domestic dye producer, followed by Switzerland's Sandoz and the U.S.'s Mobay, a subsidiary of West Germany's Bayer. Others with major positions in the U.S. dye industry include BASF and Hoechst Celanese. The only U.S.-based producers with significant full-line textile dye operations are Crompton & Knowles and Atlantic Industries of Nutley, N.J. The latter differs markedly from Crompton & Knowles in that it is also a significant importer of Japanese-produced dyes.

The U.S. dye industry is a highly competitive one whose complexion has changed considerably, especially between 1974 and 1983, when U.S. producers had more capacity than was realistically required. During those years eight major U.S. dye producers sold or dropped production of dyes: Tenneco Chemicals, Inmont, Allied Chemical, GAF, Harshaw Chemicals, Du Pont, Otto B. May, and American Color & Chemical. When Du Pont left the business in 1980, it probably turned off the spigot on 12% of industry dye capacity, industry sources say, and that still did not come close to putting demand and capacity in line.

Dye producers had hitched their wagons to a textile industry that seemed to be on a growth curve without end. In the heyday of the U.S. textile industry during the 1950s and 1960s, the widespread introduction of nylon, polyester, and acrylic into the apparel and home furnishings businesses created what seemed at the time unlimited expansion opportunities for textile mills and the dye makers who scrambled to produce dyes capable of putting color into man-made fiber garments and home furnishings.

Between 1960 and 1973, U.S. synthetic dye production grew from 156 million lb to the industry high of 284 million lb. Since that time, production levels have stagnated, rising and falling from year to year with the vicissitudes of the economy.

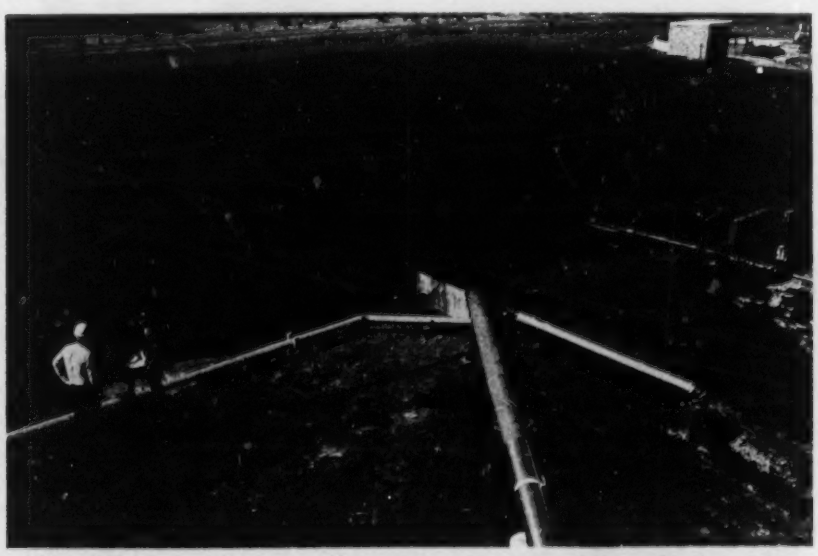
European dye makers came to dominate the U.S. market because of their low-cost position in the manufacture of the intermediates for dye production. In fact, U.S. dye makers relied heavily in the 1960s on European manufacturers for their intermediates requirements. A weak U.S. dollar in the 1970s put U.S. dye makers at a disadvantage in dye intermediates costs.

Because of their backward integration in dyes, European manufacturers have had a heavier long-term commitment to the manufacture of dyes compared with most U.S. producers. U.S. producers entered the dyes business only after World War I because of dye shortages that resulted from the war. The big European producers initially went into business in the late 19th century as developers and suppliers of synthetic dyes and from there developed their pharmaceuticals and a host of other chemical businesses. Says Gunter Thiel, Mobay's textile colorants marketing director, "We cannot afford to leave the dyestuffs business because of our inventory in it and in organic intermediates. We're here to stay."

Bayer, Mobay's parent company, has been in the dyes business since 1863, says Thiel. "We intend to stay in it at least another 125 years," he adds. But Bayer's commitment to the dyes business does not prevent it from dropping lines that are not profitable. Mobay ceased production of vat dyes at the end of 1987 and has only been selling residual quantities since, says Thiel. Mobay continues to offer basic, acid, disperse, and reactive dyes to the industry.

As a supplier to the textile business, Mobay has found that U.S. textile producers have been running strong from the second half of 1986 into 1987. This year is still a strong one, says Thiel, but some areas are spotty. Since about February and March, demand has been down for the jogging suit business, with a resulting slowdown in dyes required for these items, which are frequently acrylic or cotton items. Other areas continue to run strong, such as broadloom, mostly a nylon business, in which acid dyes are heavily used.

Peter W. Harding, manager of tex-



Huge lagoon is used to treat dilute waste at Crompton & Knowles dye plant

Dyes are separated into broad classes

Acid. Water-soluble, anionic dyes used primarily on nylon, wool, silk, and modified acrylic textiles. They consist of azo, anthraquinone, and triarylmethane compounds with a few azine, xanthene, ketone imine, nitro, nitroso, and quinoline compounds. Acid dyes are applied in the presence of an organic or inorganic acid.

Azoic. Azoic dyes are used as complementary dyes with pigments or mordant dyes on cellulosic fibers. All of these dyes contain chromophoric azo groups located between aromatic systems.

Basic. Water-soluble, cationic dyes for application to modified acrylics, modified nylons, modified polyesters, leather, unbleached paper, and inks. Acrylic, nylon, and polyester fibers are modified by incorporation of acidic groups as dye sites in the fiber to increase its ability to be dyed with basic dyes. Principal chemical classes of basic dyes are azo, anthraquinone, triarylmethane, methine, thiazine, oxazine, acridine, and quinoline. The dyes are applied in acidic dyebaths to fibers made of negatively charged polymer molecules.

Direct. Water-soluble, anionic dyes used for coloring cotton, rayon, other cellulosic fibers, leather, and paper. Dyes of this class include azo and metallized azo compounds as well as stilbenes, thiazoles, phthalocyanines, and oxazines.

Disperse. Water-insoluble, nonionic dyes used on polyester, nylon, cellulose diacetate, cellulose triacetate, and acrylic fibers. Chemical types include azo, anthraquinone, nitro, methine, and quinoline compounds. Disperse dyes are applied as aqueous dispersions, either by high-temperature pressure methods or low-temperature carrier methods.

Fiber-reactive. Water-soluble, anionic dyes containing a reactive group (such as dichlorotriazine, monochlorotriazine, or vinylsulfone) that can form a covalent bond with a compatible group on the substrate. Such covalent groups may be formed with the hydroxyl groups of cellulosic fibers such as cotton and rayon, or with the amino groups in nylon, silk, and wool.

Fluorescent brighteners. Colorless compounds that absorb incident ultraviolet light and re-emit in the blue region of the spectrum. Although not strictly considered dyes, fluorescent brighteners are used in textiles as well as in soaps and detergents and add light to a substrate. The class includes stilbene, azole, coumarin, pyrazine, and naphthalimide chemical types. Application is from solution, dispersion, or suspension.

Food, drug, and cosmetic. Synthetic organic colorants that are subject to certification by the Food & Drug Administration for use in food, drugs, and cosmetics. These dyes consist of azo, anthraquinone, carotenoid, and triarylmethane compounds.

Mordant. Mainly used to dye wool, but the class has secondary applications for dyeing silk, nylon, leather, and anodized aluminum. A mordant helps fix dye to the fiber in the form of a complex. Mordants contain chemical groups capable of reacting with salts of aluminum, chromium, cobalt, copper, and iron to give differently colored metal complexes.

Solvent. Dyes used principally in lacquers, varnishes, printing inks, and plastics. Chemical types include azo, triphenylmethane, anthraquinone, and phthalocyanine. Solvent dyes are soluble in organic solvents, which are used to disperse the dyes in the substrate.

Sulfur. Water-soluble dyes used on cotton, rayon, and cellulosic blends with nylon, acrylic, and polyester. These dyes contain sulfur both as a part of the chromophore and in polysulfide pendant chains.

Vat. Water-insoluble dyes applied in dispersions used principally for dyeing and printing cotton. Chemical classes of vat dyes include anthraquinones and indigoids.

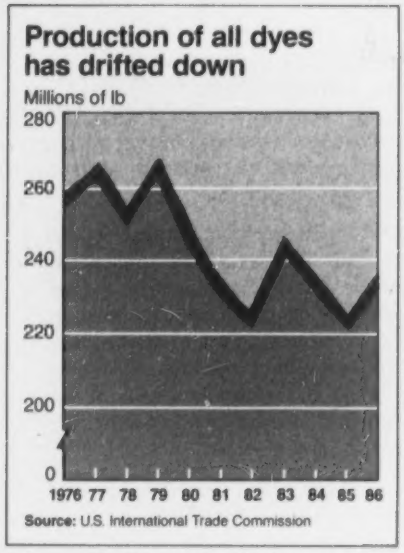
tile industry services with the consulting firm Kurt Salmon Associates, says that the domestic textile industry softened during the second quarter this year as a result of excess inventory buildups at the retail apparel level, particularly women's sportswear. He notes that women's apparel is an important sector for the dyes business and that any softness there might hurt dye makers. But he says that the softness likely will be temporary.

Aside from the vagaries of fashion and changes in demand, one of the greatest difficulties in operating a dye production facility in the U.S. is the complex regulations any such operation must satisfy. The Environmental Protection Agency must approve any manufacturer's application either to manufacture or distribute any dye in the U.S. Theoretically, when all goes well, a new dye may be approved in 90 days, says Mobay's Thiel. But when an application is challenged, the approval process can "stretch from 91 days to 900 days to nine years." Some dyes developed by parent company Bayer more than three to four years ago still do not have EPA approval.

Mobay has only one recently introduced dye. Levarfix royal blue EFR is a new reactive dye used for cotton and polyester knit goods. Thiel says that the newly introduced dye offers high tinctorial strength, high fixation and brightness, and is relatively economical.

Thiel does note that domestic dye producers have begun to see attempts by Far Eastern countries to enter the U.S. dyes market. Taiwan, Indonesia, South Korea, and China are attempting to export "garden variety dyes" to the U.S. Their cost of manufacture is generally lower than in Europe or the U.S. because of lower labor costs and either very few or no environmental restrictions.

But Thiel points out that an offshore manufacturer who is not prepared to provide a high level of technical assistance to his customer cannot essentially compete for business in the textile dyes market. Aside from the ecological assistance that domestic dye producers provide customers, they also offer quality, consistency, and efficient inventory and billing services. "This is not some-



thing a fly-by-night dealer can deliver," says Thiel.

The cost of running an efficient and responsible, not to mention profitable, dye manufacturing operation in the U.S. is very high. Crompton & Knowles officials estimate, for example, that the company spends a little more than 25% of its annual dyes division capital expenditure budget on pollution abatement controls. Ciba-Geigy, whose dye operations have received the most intensive public scrutiny, also confesses that it has spent much more than 25% of its annual capital expenditures budget on environmental controls.

Ciba-Geigy's Polson acknowledges that although the company has spent enormous amounts of money trying to answer environmental objections to its dyes manufacturing plant in Toms River, its parent company in Switzerland also sustains high costs for pollution controls. The Toms River plant, where dye synthesis will be shut down, was built in 1953 and expanded in the 1960s. The company's run-in with government environmental regulations has been especially bitter and public.

In 1985, a New Jersey grand jury delivered a 33-count indictment against Ciba-Geigy and some of its employees for illegally dumping toxic wastes into a landfill and into the Atlantic Ocean (C&EN, Nov. 4, 1985, page 10). It is no wonder then that the company wants to start dyes production with a fresh slate at a new site. The company's new plant at St. Gabriel, La., will be "technologically and environmentally sound," says Polson. Its location will be at a site where Ciba-Geigy now manufactures atrazine pesticides.

In the interim between the Toms River plant shutdown in 1989 and the startup of the St. Gabriel plant, Ciba-Geigy will supply its customers from inventories. It will not have to rely on increased imports from its parent company, says Polson. Ciba-Geigy is a supplier of disperse, direct, fiber-reactive, vat, acid, basic, chrome, and metal complex dyes.

Duncan: 1987 was a peak year

"We're going to stay in the dyes business even though it's not as profitable a business as we would like," says Polson. But there has been a change of attitude toward the dyes business at Ciba-Geigy. "We looked at the dyes business for many years as a business base," he says. "We're looking at it as a hard-nosed business now. We better stand on our own feet and make money."

Polson points out that from the late 1970s to 1985, dye prices actually declined whereas the cost of just about everything else increased. "That was not a good situation," he says. "If you are going to put in the investment, you must show a return." Ciba-Geigy is putting its money into the new St. Gabriel plant because it sees the U.S. textile industry as a viable one today.

"Eight or nine years ago, we would have hesitated to make the investment in St. Gabriel," says Polson. But the textile industry has gone through a difficult reorganization period. One enormous textile firm, J. P. Stevens, has been dismantled. Burlington Mills, though still a large mill operation, is a much slimmer operation. Numerous small mills have fallen by the wayside,

About statistics for dyes

By one estimate, the U.S. consumes roughly 14% of world textile production. On a world scale then, its demand for textile dyes is proportionately lower than pharmaceuticals, for instance, for which some estimate the U.S. consumes some 40% of world output.

Given the small U.S. share of the world textile market, and factoring in the large percentage of offshore production that goes to satisfying the U.S. demand for textiles, it is easy to understand why U.S. dye makers have had anything but a rosy market.

Government statistics don't necessarily tell the full story. They are available fairly late: nine months after the calendar year they report, with no preliminary results available in the interim. Industry insiders say the statistics are further complicated because the U.S. production estimates provided by the International Trade Commission include small but significant quantities of imported dyes that have been repackaged for the U.S. market.

One close observer of industry trends, Dieter Hoecklin, Crompton & Knowles' vice president of marketing, projects actual 1987 U.S. production at 235 million lb, up from 226 million lb the previous year. Average price per lb was $3.03 in 1987, says Hoecklin, versus $2.89 in 1986.

After correcting import statistics to include only benzenoid colorants without pigments and toners, Hoecklin estimates that 63 million lb of dyes were imported and made up about 34% of the U.S. dye market valued at $1.08 billion in 1987. His 1986 estimate shows dye imports at 56 million lb, comprising some 32% of the market, which he values at $954 million.

and the survivors have invested heavily in new machinery and equipment. Much of the textile industry's reorganization occurred as imports grew, particularly in the huge apparel market. Textile imports captured about 30% of the domestic apparel market in 1980 and grew to 50% by 1987.

According to the Textile Economics Bureau, the U.S. trade deficit for garments, expressed in millions of pounds, grew 186% from 299 million lb in 1979 to 855 million lb in 1986. The man-made fiber manufactures' trade balance, excluding garments, changed from a positive trade balance of 371 million lb in 1979 to a negative trade balance of 330 million lb in 1986.

The strong dollar had been blamed for the success of imports during much of this period. Unfair trade practices have been blamed for U.S. mills' lack of success in penetrating overseas markets even as imports flooded U.S. shores. What is very clear, however, is that as U.S. textile mills lost share in their home markets, dye producers went into a tailspin: environmental regulations, overcapacity, and a concommitant growth in dye imports took their toll on the dyes industry.

It is misleading to look at capacity utilization levels and see that the U.S. textile industry is operating at or near capacity today. Numerous mill closings have restricted capacity. But dye makers now hope to benefit from a more competitive U.S. textile industry that has invested millions of dollars in the latest textile processing equipment and automation controls. "There has been an actual slowdown of textile imports in the first months of 1988," notes Polson.

And to be more competitive, U.S. textile producers are forming an alliance with dye makers in order to respond more quickly to demand. The textile industry's "Crafted with Pride" program has helped foster greater cooperation among textile producers and suppliers. The goal, already achieved in some cases, is to get all parties to cooperate in finishing items quickly so they can be shipped to retail outlets. As a result, domestic producers can use their geographic advantage over imported items, which must make the long journey from Europe or the Far East before they can be placed in a U.S. retail outlet.

Hoechst Celanese's dyes department director Wolfgang Kretzschmar (left) and Heinz Geiss examine nylon carpet dye samples at Charlotte, N.C., laboratory

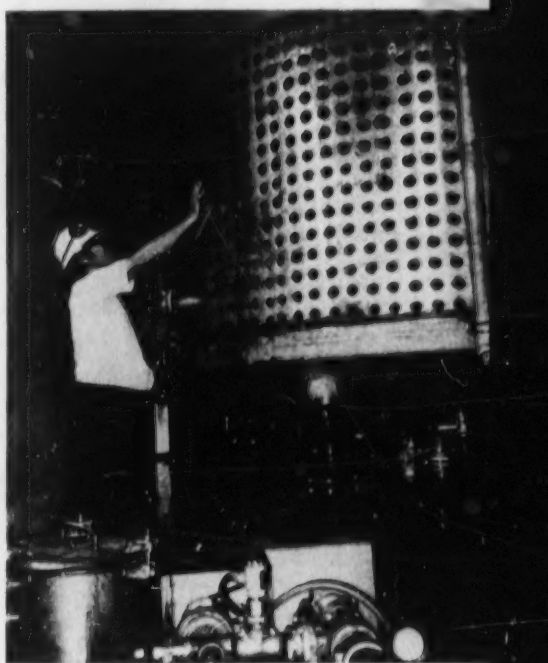
Despite its well-publicized environmental problems, Ciba-Geigy has actively sought to gain position in the U.S. dyes business. Most recently it acquired the rights to Eastman Chemical's dyes business. "Eastman added to our range of disperse dyes for custom fabrics. It was a good acquisition," says Polson. The arrangement that now exists between the two is that Eastman continues to manufacture the dyes and Ciba-Geigy distributes them. Ciba-Geigy, however, does manufacture some of the Eastman formulations in Europe for distribution there, notes Polson.

Ciba-Geigy has also introduced a new line of dyes recently. Cibacron-C is a new fiber-reactive dye. The higher reactivity of the dye means that "less of it goes down the drain," says Polson, and consequently there is less to treat and decolorize when it is discarded.

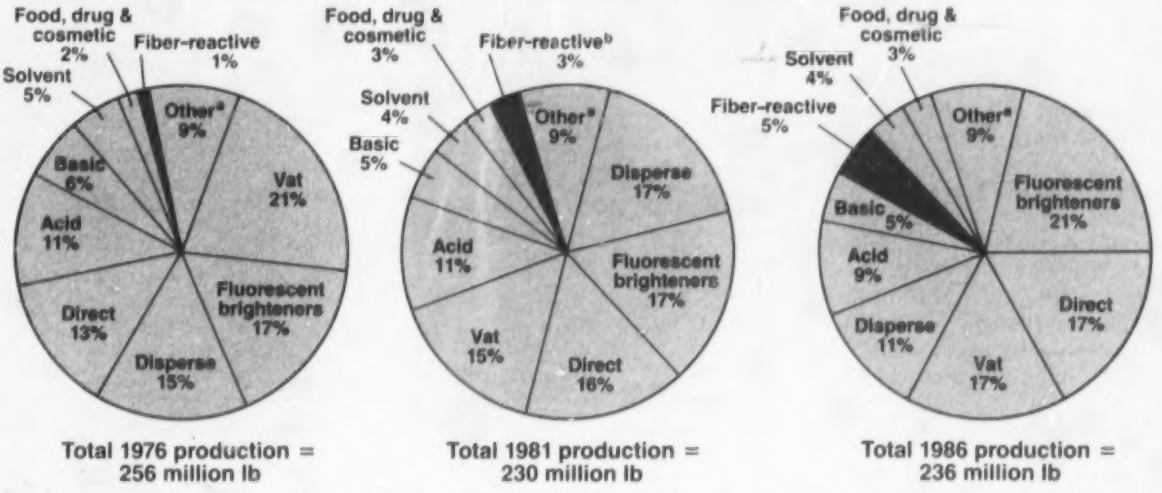
ICI Americas' Michael R. Day, business director of the Colors & Fine Chemicals Division, says that ICI's dyes business has been relatively healthy for the past few years following 1984, which he describes as a "difficult" year. "Four years ago we thought the dye business was declining at a rate of 1 to 2% a year. It's now increasing slightly on average year to year."

According to Day, ICI's Dighton, Mass., dye manufacturing plant "is running full out," partly because ICI is exporting its dyes to Europe in order to take advantage of the weak U.S. dollar.

ICI's strength as a synthetic dye manufacturer is in the fiber-reactive dyes, disperse, and direct dyes. To a lesser extent, it provides acid dyes as well. "The bulk of our business is in cotton dyeing. We've benefited by the trend to cotton-rich fabrics," says Day. ICI also supplies indigo, a natural plant-synthesized blue color.


Crompton & Knowles plant manager checks new conversion tank for dyes

Fiber-reactive dyes grew from 1% of production in 1976 to 5% in 1986



a Includes azoic, azoic diazo, mordant, and sulfur dyes. b C&EN estimate. **Source:** U.S. International Trade Commission

Like other domestic full-line producers, ICI Americas offers technical assistance to customers via its Charlotte, N.C., applications lab. Its R&D effort, however, is centered in England. Although no R&D dollar figure is available, Day says that the cost of developing a new dye runs to $500 million. That is quite high, he notes, especially since a great deal of the cost is associated with answering environmental concerns.

One industry trend that ICI is watching is the move to piece dyeing of garments. Garment manufacturers can produce any number of undyed garments that are dyed only when a retailer orders a specific color. Inventories are reduced, and popular colors can be made available more quickly. Theoretically, merchandise thus moves faster, making everybody involved in a garment's manufacture and profitable sale happier. Day estimates that piece dyeing now makes up 5% of the apparel dyeing trade and thinks it may grow to 10%.

However, Day, as well as other dye manufacturers, cautions that the piece dyeing trend could be ruined by shoddy, uneven dyeing practices. The relatively low investment required to enter the piece dye business accounts for its recent success. However, there is a danger that unscrupulous entrepreneurs could ruin the piece dye trade if too many poorly dyed articles are turned out by dyers who are after a quick dollar, notes Day.

Cotton Inc., the U.S. government-mandated fiber marketing company supported by U.S. cotton growers, has been at the forefront of garment dyeing developments. "People in garment washing have moved into garment dyeing," says R. Mike Tyndall, manager of technical services. "It's a fashion trend business."

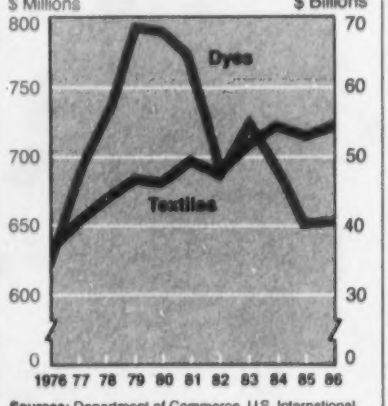
According to Wallace A. Blanton, director of technical services, Cotton Inc. is now working on advances in garment dyeing so that more tailored clothes, rather than the casual pieces now best suited for the process, can be piece dyed. "We're working on a resin finishing process that can be worked in at the end of the dyeing cycle," says Blanton. The aim is to achieve a final garment after dyeing that shows "less distortion of the fabric." He says that hopefully with "the proper softening and pressing techniques, we can get a tailored look."

According to ICI's Day, the company not only forecasts piece dye growth, but it also attempts to guess color demand. He admits, though, that they are not always successful. "Over the past six months, blacks and reds have been popular. No one forecasted that, and, as a result, there are some shortages in those colors."

Color forecasting is particularly difficult, says ICI's Duncan, because of what he calls "the communications explosion" today. "Young kids determine today's colors and style," he explains. Colors and styles last for 18 months at the most, he says. "Once the older generation wears it, that kills the style or color." Duncan says he watches his teenage daughter's wardrobe in order to predict color trends.

Fashion changes can put a crimp into dye production, notes Crompton & Knowles' Alcorn. Although

U.S. dye sales have fallen as textile's have climbed



Sources: Department of Commerce, U.S. International Trade Commission

pale shades may take up only 1% of a fabric's weight, deep shades may take up 5%. One drawback in the trend toward soil- and stain-resistant carpeting now heavily promoted in the retail market, notes Alcorn, is the tendency for consumers to chance lighter-colored carpets on the promise that the new generation carpeting will resist staining.

Even changes in fiber preferences by consumers can have a decided impact on dye class sales. With the recent decline in demand for woven polyester fabrics, Alcorn says he has noticed a dropoff in sales of disperse blue dye. A more recent drop in acrylic fiber demand will affect sales of acrylic sweater component dyes. Fiber-reactive dye sales have benefited, he notes, because of heavy consumer preference for cotton.

Crompton & Knowles has survived as the only major full-line, U.S.-based dye producer. Its specialty chemicals unit, the bulk of whose business is dye production but also includes flavors, fragrances, and organic intermediates, had 1987 sales of $152 million and an operating profit of $19 million. That division contributed 64% of 1987 corporate sales and 69% of the company's profits.

Crompton & Knowles' commitment to the dyes business is large, points out Vincent A. Calarco, chairman, president, and chief executive officer of the company. He estimates that the dyes business as a percentage of overall company sales is now roughly at 43%. "Dyes are big. They are a core business."

Thiel: in dyes business to stay

Day: growth ahead in piece dyeing

The company produces disperse, acid, fiber-reactive, direct, basic, and solvent dyes in Redding, Pa.; Gibraltar, Pa.; Lowell, N.C.; and Newark, N.J. "We see the dyes business as a true specialty chemicals business," says Calarco, in which customer service is a very important factor. The large, diversified U.S. chemical producers who left the dyes business, such as Du Pont and Allied Chemical, only derived a small percentage of their overall sales from the dyes business, Calarco points out. Crompton & Knowles has a hefty position in dyes relative to the company's overall size, he notes.

Crompton & Knowles' vision of the dyes business is not unlike that of its major European competitors. "Dyestuffs are a world market," says Alcorn. "We were the only American company to build a dyes plant in Europe 20 year ago," he points out. To learn the dyes market on its strongest competitors' turf, the company endured "five years of breakeven profits at best," he says. The company sees itself as an international dye producer. It recently took a small position in the Far East dyes market when it established a joint venture in Bangkok with Thai Ambica Chemical Co.

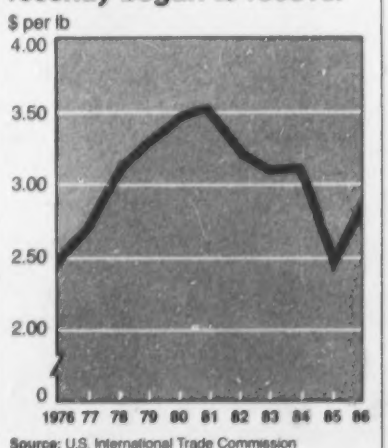
"Our approach is to focus on key market segments that are less import-sensitive," says Alcorn. Those bright spots include special lightfast dyes for automotive fabrics and carpet dyes, he notes. Within those key market segments, technical service and shorter dye runs are the focus, he points out.

An aid to Crompton & Knowles' profitability is that dye prices are rising again after the downward spiral of recent years. Calarco attributes price improvements to a 20% reduction of dye capacity in the U.S. over the past five years. Alcorn adds that another impetus for higher dye prices is the worldwide shortage of dye intermediates. Still another impetus toward price improvements is the willingness of textile customers to pay a price for the higher quality and just-in-time deliveries required as a result of the U.S. textile industry's attempt to implement the quick delivery strategy behind its "Crafted with Pride" program.

Recent new dye introductions from Crompton & Knowles include three high-concentrate liquid acid dyes for the nylon carpet trade. A new acid red, Nylanthron red S-BL, is now in limited production, too. "We think we're leaders in liquid acid dyes for carpeting," says Alcorn.

Environmental costs are a major factor in operating dye plants, notes Alcorn. They figure heavily in what he estimates is the close to $1 million cost to bring a new dye product into the market. As for dealing

Dye prices have only recently begun to recover



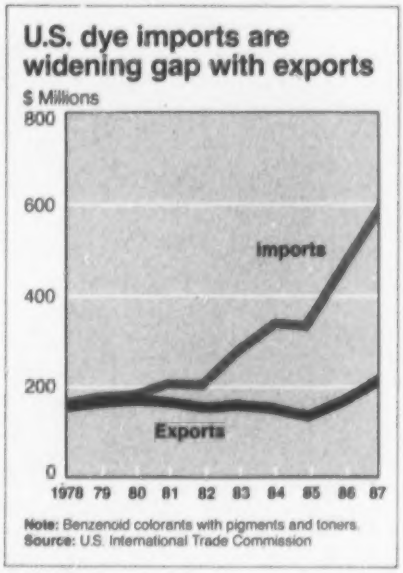
Source: U.S. International Trade Commission

with wastewater streams at its dyes synthesis sites, individual plants dedicated to the production of chemically similar dyes "give us a flexible base to meet government requirements," he says. Each of the four dye production plants Crompton & Knowles operates does not "have to handle multiple waste streams," which would, he says, increase effluent treatment costs geometrically.

Similar to Crompton & Knowles, Hoechst Celanese believes that the dyes industry has recovered since 1985. "A strong consumer preference for cotton, cotton blends, rayon, and bright deep shades" in the apparel business has helped, says Hoechst Celanese's Geiss. With two production facilities for vat, fiber-reactive, acid, disperse, and sulfur dyes—one in Coventry, R.I., and the other in Mt. Holly, N.C.—Geiss says that Hoechst Celanese is "one of the three largest U.S. textile dye producers." More than 80% of the dyes the company sells are produced in the U.S., he says. One new formulation, a modified acid dye line, Remalan, promises brighter shades than conventional acid colors, he says.

Hoechst Celanese is especially proud of its own color matching service for customers. Though other dye manufacturers offer quick response color, Hoechst Celanese says that customers can call with spectrophotometer readouts that are put into a color computer. "We can match most colors in 10 minutes and call back the customer with the formulation," says Geiss. The spectrophotometer "effectively reduces formulation response time from an average of one week to 15 minutes," he says.

Calarco: customer service a big factor



Sandoz also has experienced improvements in prices and thus the margins it is able to get from dye sales, notes a spokesman for the company. The producer of acid, disperse, basic, vat, sulfur, and fiber-reactive dyes has U.S. manufacturing sites in Martin, S.C., and Mt. Holly, N.C.

Although some dye producers have noted their ability to supply liquid dyes, the Sandoz spokesman also points out that his company's new granular form fiber-reactive dye reduces dusting problems and thus promises easier handling for dye users. The granular dye line, Drai-marine CDG, will be available in late summer and offers instant solubility in a dry form at higher strengths than liquid dyes, he says.

A spokesman for BASF, a producer of acid, disperse, vat, fiber-reactive, metal complex, and indigo dyes, agrees with the industry assessment that the dyes business is improving in the U.S. along with the textile business. The company produces both intermediates and dyes at Rennselaer, N.Y.

Although domestic dye producers generally agree that the industry has regained a certain measure of profitability since 1985, it does have a way to go before it reaches the nearly $800 million in sales it had in 1980. Unit pricing also has a way to go before it too reaches the $3.53 average price per lb the U.S. International Trade Commission reported in 1981.

The companies still engaged in dyes synthesis in the U.S. say they are committed to the business for the long term. Many have rationalized their production while still putting the dollars into research for newer and better dyes. They have continued to provide a high level of technical service while also working to implement the "quick response" effort that all elements of the textile industry have embraced in order to make the U.S. textile industry more competitive with overseas players.

Trying to meet the burden of compliance with environmental regulations has been costly, but no one has withdrawn from dye production solely for environmental reasons. Even though Ciba-Geigy appears to have "taken it on the chin" at Toms River, it has continued to commit itself to dyes synthesis in the U.S. at its new St. Gabriel plant.

Although hoping that 1988 will be a good year for the dye industry, many producers continue to watch the textile industry anxiously. Record heat and drought have created some concern about the availability of water so necessary to textile processing and dyeing. So far, however, no severe water restrictions have compromised textile production and dyeing. A spokesman for Dalton Public Utilities in Georgia says that water restrictions there have not hurt carpet manufacturing and dyeing in that center of the U.S. broadloom manufacturing business. All broadloom plants continue to dye on a five-day schedule, except that water use is staggered so that some plants operate on Saturday and Sunday to make full use of stream flows. But the spokesman cautioned that it has been a dry year. And this natural phenomena may yet force production cutbacks for the textile producers, with resultant cutbacks in dye use. □